

**Notes on the Biology of *Pseudocotalpa giulianii*
Hardy (Coleoptera: Scarabaeidae)**

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Hardy (1971) described the genus *Pseudocotalpa* from a series of 120 specimens from the Algodones Sand Dunes near Glamis, California (*Pseudocotalpa andrewsi* Hardy). Two additional species were described from sand dunes, one from Puerto Penasco, Sonora, Mexico (*P. sonora* Hardy) and the other from Big Dune, Nevada (*P. giulianii* Hardy) (Hardy, 1974). Hardy (1976) described the mating behavior of *P. giulianii* and Hardy and Andrews (1981) discuss the biology of *P. andrewsi*. Here I report on various aspects of the biology of *P. giulianii* as studied during the adult activity periods in 1979 (1 day), 1980 (1 day), 1981 (2 days), 1982 (9 days) and 1983 (1 day).

Adult *Pseudocotalpa giulianii* are light tan scarabaeid beetles with more yellowish pronotum and head, the legs are darker with reddish brown tarsi and claws (Fig. 1). They are between 17 to 25 mm long and 7 to 10 mm wide (Hardy, 1974). Males and females are similar in appearance, but easily distinguished by the size of the tarsal claws; female claws are equal whereas the outer tarsal claw of the male is twice as long as the inner.

Pseudocotalpa giulianii is known from two sand dunes in southwestern Nevada: Big Dune 16.5 km west Lathrop Wells, Nye County (116°35'W, 36°38'N) and Lava Dune 10 km west-northwest Lathrop Wells, Nye County (116°30'W, 36°41'N) (Fig. 2). The dunes are 6.5 km air distance apart. Big Dune is a complex star dune with an area of 4.0 km² and is 755 m in elevation. Lava Dune is sand trapped in a lava flow at the base of a cinder cone. It has an area of 2.8 km² and is 853 m in elevation. Three other dunes in the Amargosa Desert have been surveyed for the presence of *P. giulianii*, but none have been found. The dunes are, Skeleton Hills sand area (10 km southeast Lathrop Wells, NV), Dumont Dunes (37 km south Shoshone, San Bernardino County, CA) (Hardy and Andrews, 1976) and IbeX Dune (southeast corner of Death Valley National Monument, San Bernardino County, CA).

The dunes lie in the creosote shrub desert of North America. The dominant plants at Big Dune are *Petalonyx thurberi* Gray (sandpaper plant), *Argemone corymbosa* Greene (prickly poppy) and *Astragalus lentiginosus* var. *variabilis* Barneby. *Larrea tridentata* Cav. shrubs surround the dune and grow in the sand along the mid-eastern edge of the dune. Lava Dune dominant plants are *Larrea tridentata*, *Petalonyx thurberi* and *Ambrosia dumosa* (Gray) Payne. At both dunes, there is a spring display of 15 to 25 species of annuals.

Climatologically, the dunes can be characterized as hot-dry desert. Mean annual temperature is between 15.5 to 18.3°C (60-65°F) with a mean of 90 days of 32.2°C plus (90°F+) and a mean of 90 days of 0°C or below (32°F-) temperatures or an average 200 day growing season. Annual precipitation is about 11 cm which falls as rain primarily in the winter months (Houghton et al., 1975).



Figure 1. *Pseudocotalpa giulianii* Hardy as it emerged from the sand just prior to flight.

ADULT ACTIVITY

Adult beetles emerge in late April (Hardy, 1974, 1976) and appear most evenings just before sundown. Males and females were very visible, hovering over *Petalonyx*, *Larrea*, *Salsola kali* L. or *Argemone corymbosa* shrubs or plants. These individuals are in a slightly head-up position and maintain an almost stationary flight over the shrubs. When disturbed, they fly from the shrub towards the dune or another shrub. Although much less common, males were observed hovering from 10 to 30 cm over areas of bare sand. Beetles flying towards the steeper parts of the dune often flew into the sand after about 20 to 30 m of flight, they would usually recover and fly off again up the slip face of the dune. The number of beetles above the shrubs was quite variable and depended on plant size and wind speed. Four of the 14 study days, no beetle flight was observed because of strong winds although beetles were present on the dunes. Aerial sweeping above one large *Larrea* shrub produced 54 beetles in less than one minute. On another occasion (16 May 82) 132 adults were collected by two collectors in approximately a 10,000 m² area during 25 minutes. On the preceding evening, only 17 adults were observed in the same area. Adult flight measured on six days in three different years began 2 to 20 minutes (mean 9:30 ± 6:18 minutes) before sundown and lasted, as determined by the absence of groups of beetles flying or hovering about shrubs, 15 to 50 minutes (mean 24:45 ± 13:30 minutes). Air temperatures at the initiation of flight ranged from 21 to 26°C (mean 23.5 ± 2.2°C) and soil temperatures at 7.6 cm ranged from 32 to 34°C (mean 32.6 ± 0.8°C). Beetles were found active on the dune later in the night (22:30) but not in flight and on one occasion (17 May 82) adults were seen on the surface just before sunrise.

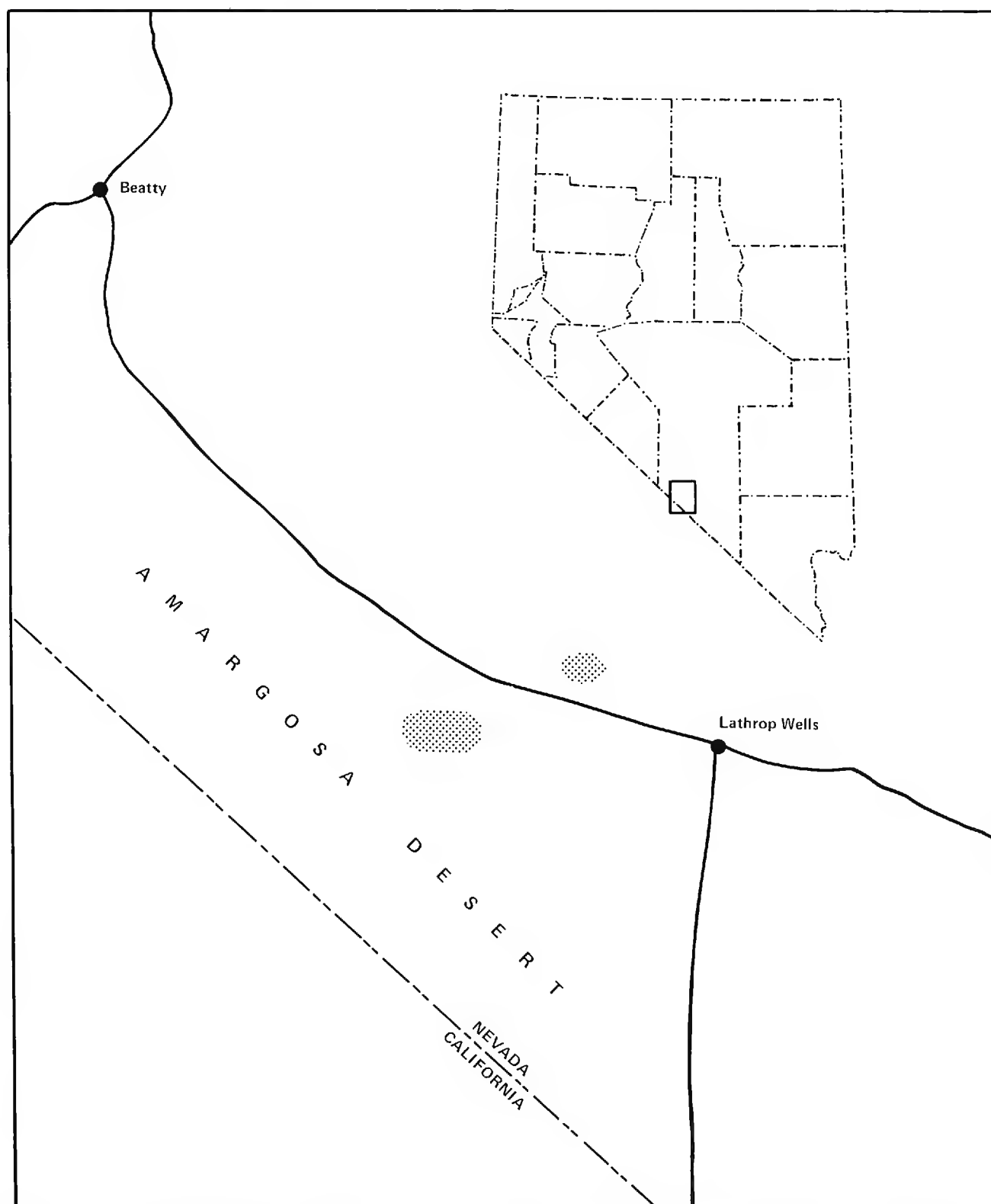


Figure 2. Known distribution of *Pseudocotalpa giulianii* Hardy. Big Dune on left, Lava Dune on right of highway.

Beetles re-enter the sand in the loose slip-face of a dune, although initial, unsuccessful attempts were observed on hard packed sand and sand-pebble soil of interdune areas. The front legs are used as scoops working the sand from anterior to posterior and dorsal to ventral from the area around the beetle's head region. The middle legs support the beetle and may aid in moving the sand. The hind legs are held out-stretched and are not used in support or sand movement. The beetle twists its way head-first into the sand and after disappearing the circular wave is still visible as the beetle "cork screws" its way deeper. Time required to dig out-of-sight averaged $3:15 \pm 0:48$ minutes (5 beetles measured on the same night). The next morning these beetles were found between 8 and 33 cm below the surface (mean 18.6 ± 12.8 cm).

During the study, 31 mating attempts and 5 matings were observed. In all cases the behavior took place on the sand surface and once a mating pair was observed at the base of a *Petalonyx* shrub, but still on the sand. The male was on top and held the female with his fore tarsi holding under the anterior edge of her elytra. Its mid tarsi were initially attached to the lateral edges of her elytra and when the female became motionless the male's mid tarsi moved to the female's hind legs near the apical tibial spur. The male's hind tarsi were attached to the female's hind tarsi pulling her hind legs back and up. Observed copulations lasted from 1:05 to 4:30 minutes. Males often remained holding the female after copulation for 1 to 15 minutes. Most mating attempts failed because of or due to interference from other males or very active females. Male interference was most common early in the season (late April to early May). Also, late in the season many male-male encounters were observed.

Examination of 10 female reproductive tracts showed the presence of developed eggs. Five females from 30 April 1982 had an average of 8.4 eggs (range 4–10) and another sample of 5 from 17 May 1982 had an average of 1.4 eggs (range 0–6). Eggs are oval and measure 3.0 to 3.5 by 2.5 to 3.0 mm. In a female with 10 eggs, the eggs almost fill the abdominal cavity. Nothing is known of egg placement; speculation is that they are deposited in the sand near the roots of shrubs.

The sex ratio of field collected individuals is skewed towards the males 1:0.24 males to females. This is for beetles presented by Hardy (1974) and examined by me or more than 450 individuals from 9 collections and 5 years. This unexpected ratio may result from females not flying to shrubs after they have been mated; however early season samples showed the same ratio. Females may have a staggered emergence with new individuals appearing throughout the adult period.

Adults apparently do not feed. Examination of digestive tracts showed no food material.

LARVAL ACTIVITY

Only 2 larvae have been recovered, both by sifting sand. Both were found beneath *Petalonyx thurberi* at a depth of 20 to 40 cm. It appears that larval development may take 2 or more years. Larvae uncovered in May 1982 were immature (small in size averaging 12 mm in length when compared to an adult 17–25 mm in length) suggesting that at least a second growing season was necessary to complete their development. Larvae apparently feed on plant roots; their digestive tracts were filled with masticated plant material. Other related genera feed on plant roots (Ritcher, 1966).

POPULATION STRUCTURE

Attempts to quantify adult population structure have failed. Mark-release-recapture of adults resulted in no recaptures of 85 beetles marked with paint during the 1982 study. Pitfall trapping (6 transects of 10 traps each at 10 m intervals at Big Dune and 3 transects at Lava Dune with 0.951 (11.5 cm diameter) plastic cartons buried level with the sand surface and one-third to one-half filled with ethylene glycol and covered with 13 × 13 cm Masonite lids held 2 cm above the carton) produced four beetles (2 at Big Dune and 2 at Lava Dune) in 49 days of trapping (hundreds of *Eusattus muricatus* (LeConte) (Tenebrionidae) were trapped during the period).

DISCUSSION

Members of the genus *Pseudocotalpa* are restricted to sand dune habitats (Andrews et al., 1979; Hardy, 1971, 1974; Hardy and Andrews 1976, 1981). Several of the observed behavioral characteristics for *P. andrewsi* and *P. giulianii* are the same: late spring adult emergence, nightly flights, hovering over dune shrubs, limited nightly activity, mating on the sand surface, adults that do not feed and larvae found beneath dune shrubs. They differ with respect to the initiation of adult evening activity, *P. andrewsi* begins after sunset and *P. giulianii* before. Hardy and Andrews (1981) found that *P. andrewsi* flight activity began when the light intensity dropped to about 44 lux (4 foot candles) and before that they remained quiet. They also reported the presence of large, approximately twice as long, individuals of this species from the interior of Algodones Dune. I have never seen a [living or collected] specimen of a large *P. giulianii* from Big Dune or Lava Dune, but these dunes are much smaller and Big Dune more mountainous than Algodones Dunes. Night hawks were observed preying on *P. andrewsi* by Hardy and Andrews (1981); no predation on *P. giulianii* was observed at Big Dune or Lava Dune although many potential predators were observed.

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